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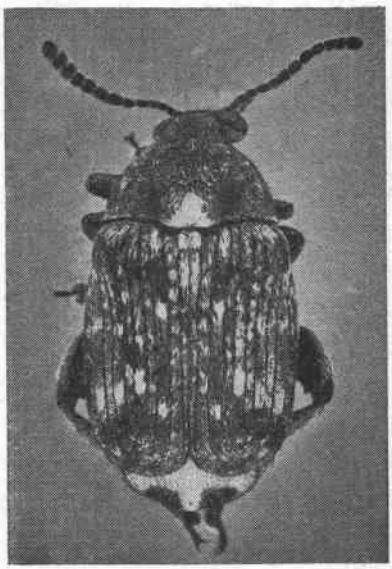
Suggestions for the Control of the Pea Weevil in Oregon with Especial Reference to Peas Grown for Processing

By

J. C. CHAMBERLIN and K. W. GRAY



Oregon State System of Higher Education
Oregon State College
Corvallis
Cooperating with the
United States Department of Agriculture
Bureau of Entomology and Plant Quarantine

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Illustration on cover—

The pea weevil, which can now be controlled, has been one of the most important factors limiting the growth and prosperity of the pea industry in Oregon.

SUMMARY

Pea weevils may be controlled. The pea weevil may be controlled by the use of dust mixtures containing three fourths of one per cent of rotenone.

One to three dustings necessary. From one to three dust applications to the infested portions of the field have been found necessary for pea-weevil control.

Proper timing of dust applications essential. Proper timing of dust applications is essential for satisfactory results. The first application should be made when peas first come into bloom but before pods have set. Later applications will depend on weevil migrations that may enter the field after the first application has been made. Your county agricultural agent should be consulted in this connection.

Hooded dusters recommended. Most satisfactory results are obtained by the use of hooded dusters; since these may be operated even under windy conditions and thus make better timing possible.

Rate of dust application. Dusts should be applied at the rate of 20-25 pounds per acre covered.

Home gardens. Hand dusters may be used to control the pea weevil in home gardens. Dusting should begin when the peas start to blossom and should be repeated at weekly intervals thereafter throughout the growing season.

Sanitation measures to reduce weevil infestations for succeeding years. Viner refuse should be used for ensilage, or spread on the fields and plowed under within a few days. All peas left on the fields should be plowed under to a depth of 6 to 8 inches immediately after harvest. Vines in home gardens should be pulled and destroyed as soon as the peas have passed the edible stage.

Suggestions for the Control of Pea Weevil in Oregon with Especial Reference to Peas Grown for Processing

By J. C. CHAMBERLIN, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, and K. W. GRAY, Oregon Agricultural Experiment Station.*

INTRODUCTION

THE purpose of this publication is to present to the growers and others interested in the pea industry recommendations and suggestions for the control of pea weevil in freezing and canning peas. The detailed results of the extensive investigations upon which these recommendations are based are of technical interest only and will be published elsewhere.

DISTRIBUTION AND ECONOMIC IMPORTANCE OF THE PEA WEEVIL

The pea weevil, *Bruchus pisorum* Linné, is one of the most important insect pests of field and garden peas. This insect is nearly world wide in its present distribution and has been known and regarded as a menace, particularly to seed-pea production, for many years. In Oregon it occurs in varying abundance wherever peas are grown. It has become of increasing importance in recent years in the states of the Pacific Northwest, largely as the result of two factors. First, increased acreages devoted to pea production have provided every opportunity for the increase and spread of the insect. Second, there has been a greater appreciation of the extent of losses directly and indirectly resulting from its depredations.

Losses are especially heavy in the case of garden and canning peas. Because close inspection is required to detect the occurrence of weevil grubs in green peas, even where moderately abundant, their presence has only rarely come to the attention of consumers.

Weevily peas (Figure 3) are unfit for human food and are regarded as adulterated under the Federal Food and Drugs Act. In the case of seed peas, the presence of the weevil seriously affects their germination, and large losses also result because of the necessity of separating the weevily from the sound peas before they are fit for sale. Where infestation is high the crop loss resulting from separating and discarding the unsalable weevily peas may run very high. With Austrian winter field peas, where germination has been the main criterion of salability, the situation has been combated by early harvest followed by immediate fumigation, which kills most

* The authors' names are given in alphabetical order.

of the larvae while still too small to have seriously affected the germination of the seeds. Even here, however, large losses occur because under the best of conditions some of the weevils have matured sufficiently to destroy the viability of the peas. These losses rapidly increase and may become nearly total in cases of unavoidable delay in either harvesting or fumigation. It is evident that under these conditions control of the pest is essential to the continued welfare of both the canning and seed-pea industries.

SEASONAL HISTORY OF THE PEA WEEVIL

The pea weevil spends the winter in the adult stage. Some of the more common places where these beetles may be found in hibernation are under loose shingles or in any cracks in buildings, under loose bark, in

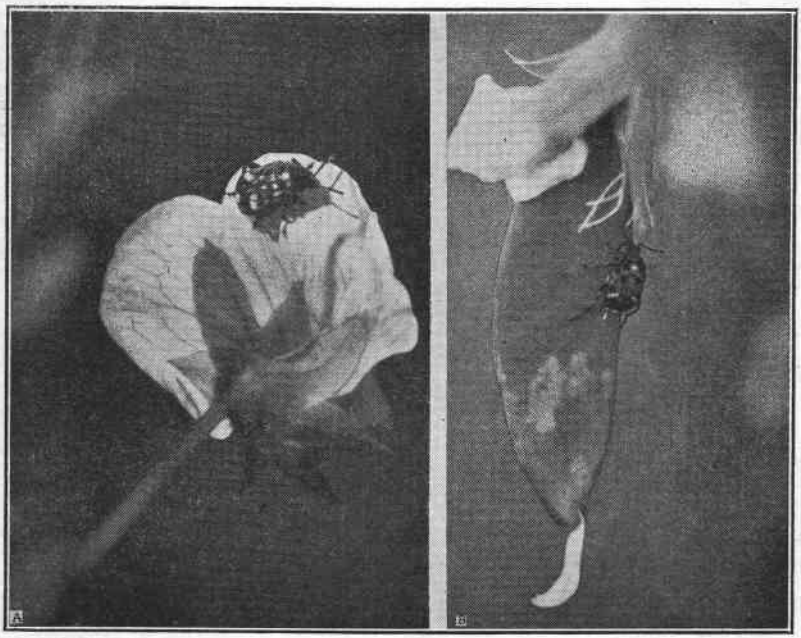

Figure 1.
A: The beetles leave hibernation and seek blossoming peas. They feed principally upon the flowers.

B: The females begin laying eggs on the pods as soon as they are formed.

moss, in debris under trees, and in cracks in fence posts. In general, any place into which they may crawl for protection from predators and severe weather conditions will serve as suitable hibernating quarters.

The beetles begin leaving their winter quarters at about the time the first peas begin to blossom. When they find blossoming peas, they begin feeding, principally on the flowers (Figure 1, A). They mate, and by the time the pods are formed or shortly thereafter, the females begin laying

eggs (Figure 1, B). They deposit eggs only on the green pods (Figure 2, A). The eggs are a bright yellowish or orange color, nearly cylindrical, and about one twenty-fifth of an inch long. Previous records indicate that a single weevil may lay over 700 eggs but that the average is probably from 425 to 450. The eggs hatch in from less than a week to more than 2 weeks. This period, apparently, depends largely upon the prevailing temperature.

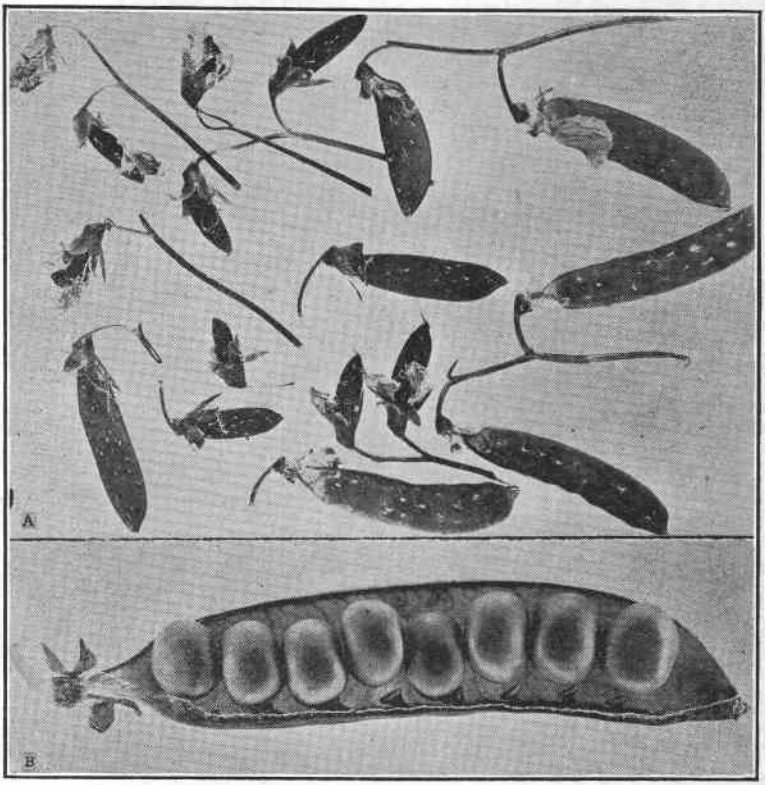

Figure 2.

A: The eggs, laid only on green pods, are a bright yellowish or orange color, nearly cylindrical and about 1/25 of an inch long.

B: Upon hatching the young larvae bore through the pod and into the peas. The small holes in the green peas are the only evidence of the presence of the larvae until they are full grown.

Upon hatching, the young larvae bore through the pod and enter the peas. The small holes in the green peas (Figure 2, B) are the only evidence of the presence of the larvae until they are full grown. The larvae feed and develop inside the peas (Figure 3). The larval development requires from 4 to 8 weeks. Most larvae develop in about 41 days. At the completion of this stage, the mature larvae cut through or nearly through the seed coat, leaving the typical circular caps or "windows" over the cavities occupied by the developing insects. The full-grown larvae then transform to the pupal or resting state (Figure 3), and then change to the adult stage

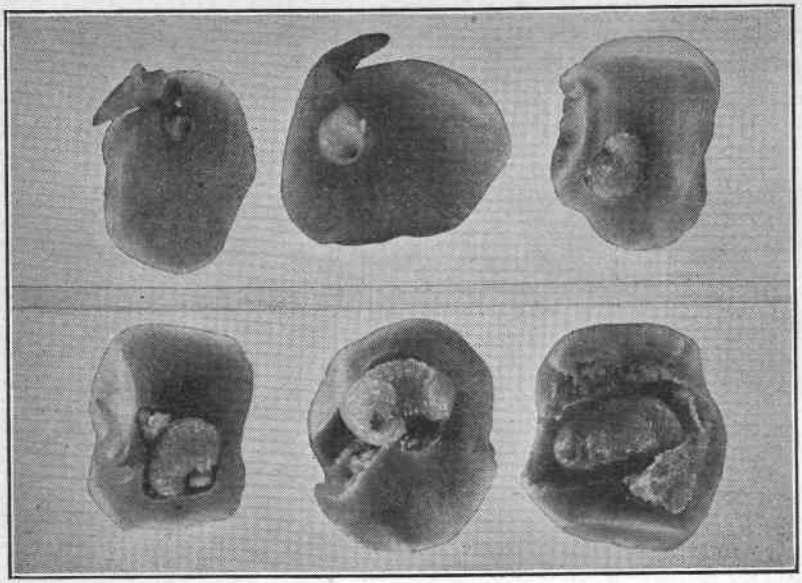

Figure 3. It is the feeding of the larvae that reduces germination. The larvae feed and develop entirely within the peas. The full-grown larvae transform to the prepupal and through the pupal stage inside the peas.

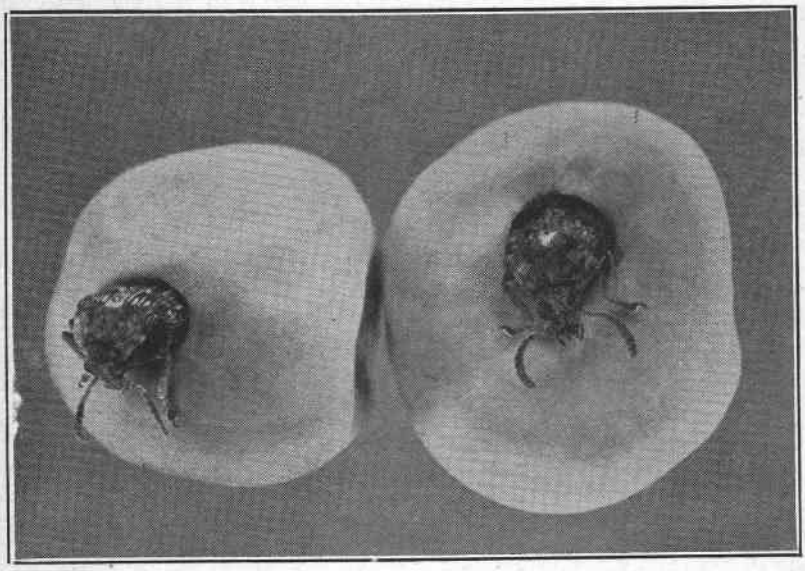

Figure 4. The weevils leave the peas and seek hibernation quarters shortly after completing the immature stages, unless the peas are stored in a cool, dry place.

within the pea. The pupal stage requires about 2 weeks. If the seed is stored in a cool, dry place, the adult weevils may remain inside the peas until the following spring. Generally, however, they leave the peas (Figure 4) and seek hibernation quarters elsewhere. This occurs almost immediately upon completion of the immature stages in peas left on the field after harvest. It requires from 7 to 12 weeks for development from egg to adult. There is but one generation per year. The pea weevil does not reproduce in dry seed as does the bean weevil.

HISTORY OF CONTROL STUDIES

The use of insecticides for control of the pea weevil has been tested many times, but it is only in the last few years that really effective direct control measures for this insect have been developed. Some success had been achieved in the use of calcium arsenate dusts as early as 1933-34, and dusting with this material has been a regular practice in certain parts of the Willamette Valley ever since. The control obtained by the use of calcium arsenate dusts, however, has not been sufficiently good to justify its general recommendation. This is especially the case when the dangers of arsenical residues to man and domestic animals are considered.

With the discovery that the pea weevil was especially susceptible to rotenone-containing compounds, advances along the line of direct control were rapid, and it is now possible to offer definite and tested recommendations for the control of this pest in peas used for freezing and canning purposes. Investigations have not yet progressed far enough to include specific recommendations for Austrian winter field peas or other peas used for seed.

The continued protection of a seed crop involves questions that do not arise in the case of a canning crop, and these points must be further studied before specific recommendations can be formulated. It is believed, nevertheless, that the program here presented for weevil control in green peas will be at least helpful in the case of seed peas.

The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture under the leadership of Mr. A. O. Larson at Corvallis, Oregon, and Dr. T. A. Brindley at Moscow, Idaho, conducted certain small scale tests on the use of rotenone-containing dusts for weevil control in 1935. The results achieved were promising, but not conclusive. During this same year two Japanese research workers* published a brief paper on pea weevil control which pointed out that rotenone-containing sprays were the most effective among a considerable number of materials tested.

Extensive cooperative investigations on insecticides for control of the pea weevil were inaugurated in 1936 by the Oregon Agricultural Experiment Station and the United States Bureau of Entomology and Plant Quarantine. These studies were conducted in connection with freezing peas in the lower Willamette Valley and were made possible by the grant of funds to the Agricultural Research Foundation by the B. E. Maling Company, Inc., of Hillsboro, Oregon. Preliminary tests on early peas

*Kuwayama, Satoru, and Kazue, Endo.
1935. Studies on the pea weevil in Hokkaido. Part 1. Spraying experiments during the young pod stage of the pea plant. Hokkaido Agri. Expt. Sta. Report 34:43-59. (In Japanese with English Summary.)

strongly indicated the effectiveness of rotenone-containing dusts and sprays. Further tests with rotenone-containing dusts under commercial conditions on late peas in Columbia County bore out these results and made it possible to formulate a tentative program of weevil control. This program was thoroughly tested in 1937 under field conditions on extensive acreage in the lower Willamette Valley, and in Umatilla County of Eastern Oregon. As a result of these studies it is now possible to present a program of weevil control for freezing and canning peas which, if effectively applied, can be depended on to yield satisfactory results.

DUSTING EQUIPMENT

Suitable equipment is as important as any other single item in combating the pea weevil. Early experience with field applications of insecticides clearly indicated that ordinary dusting equipment was not entirely satisfactory for use in the control of this pest. Excellent results may be

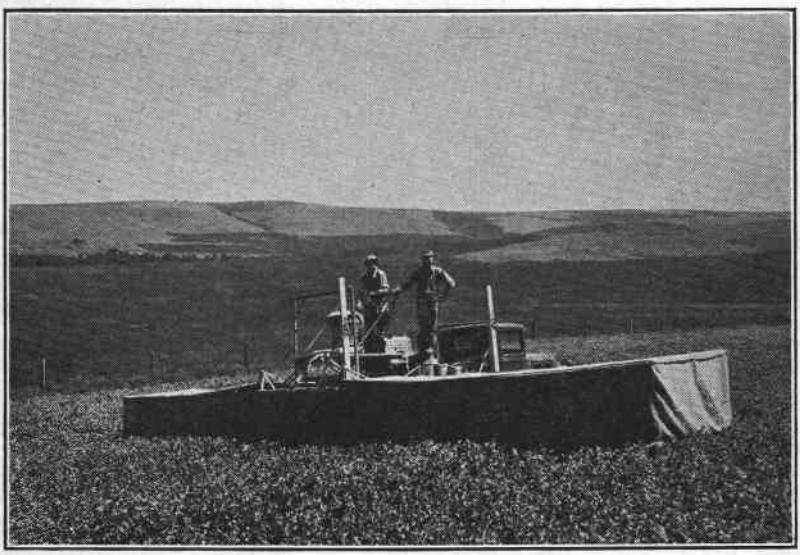

Figure 5. The largest hood used in 1937 covered 40 feet at a swath. The dusting unit and hood could be quickly removed from the truck bed and the truck used for other purposes.

obtained with such equipment when weather conditions are ideal; that is, when there is no wind. Since such conditions do not occur frequently and are usually of short duration, it is necessary to use dusters so constructed that they may be operated under windy conditions in order that the dust applications may be made at the correct time.

What may be called a "hooded duster" appears to overcome the difficulties previously encountered. Figures 5 and 6 are illustrations of dusters incorporating the hood. The hood consists merely of a canvas or burlap box, built over the duster nozzles and supported at the top by a rectangular

frame. The ends of the frame are supported by guy wires, chains, or rods fastened to a tripod which is attached to the frame of the machine. The lower edge of the hood is weighted by pieces of lead, chain, or rods to prevent too much whipping by wind. No rigid supports extend from the top to the bottom of the hood. This allows it to pass over rough ground without danger of damage to the machine. The width of the hood from front to back is 4 or 5 feet and the depth is 36 to 40 inches. The length will

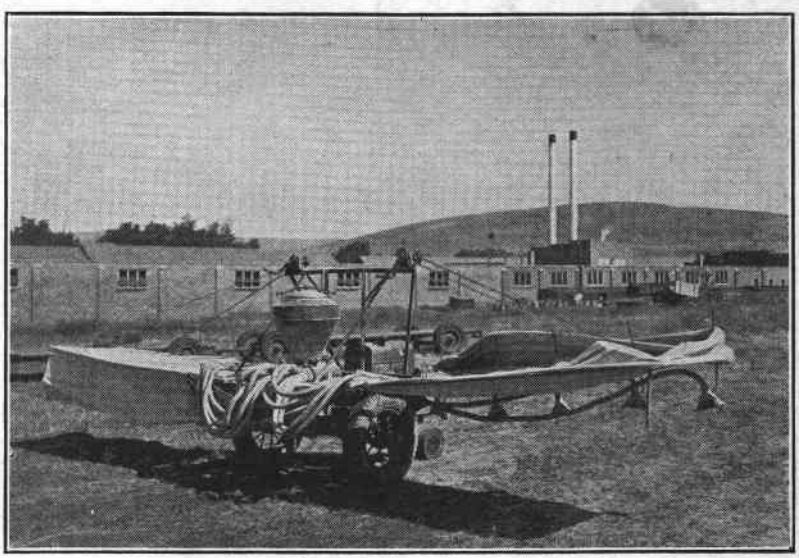

Figure 6. A duster mounted on a trailer can be used in steep, rough fields where only tractors or horses can travel.

vary with the size of the duster unit to be used and the speed at which the machine is to travel. The manufacturer's specifications as to the amount of dust discharged per unit time for the duster to be used will govern the length of the hood. For example, a machine discharging dust at the rate of seven pounds per minute and traveling 5 miles per hour will give satisfactory coverage with a 30-foot hood. Hoods so far used have ranged from 20 to 40 feet over-all.

An arrangement whereby the hood may be adjusted for distance from the ground is necessary to allow for varying height of vines. The bottom of the canvas or burlap should brush the tops of the vines. This insures that all the dust discharged by the machine must pass through the vines before the wind causes it to drift away (Figure 7). It also permits enough of the insecticide to adhere to the vines to effect a satisfactory kill. Figures 7 and 8 show hooded dusters in operation.

The arrangement of the discharge nozzles under the hood appears to have little definite bearing on the efficiency of the machine. In some, a row-type arrangement has been used (Figure 6). When operated in conditions of high humidity some difficulty was experienced with this design.

The nozzles occasionally touched the wet vines and gradually became clogged. With this arrangement there is also danger of tearing out vines as well as damaging the equipment when operated on rough ground. Figure 9 illustrates the simplest design used. One large nozzle was directed into each wing of the hood and one forward under the machine. This design gave as satisfactory results as the row-type arrangement and no difficulty was experienced from nozzles becoming clogged.

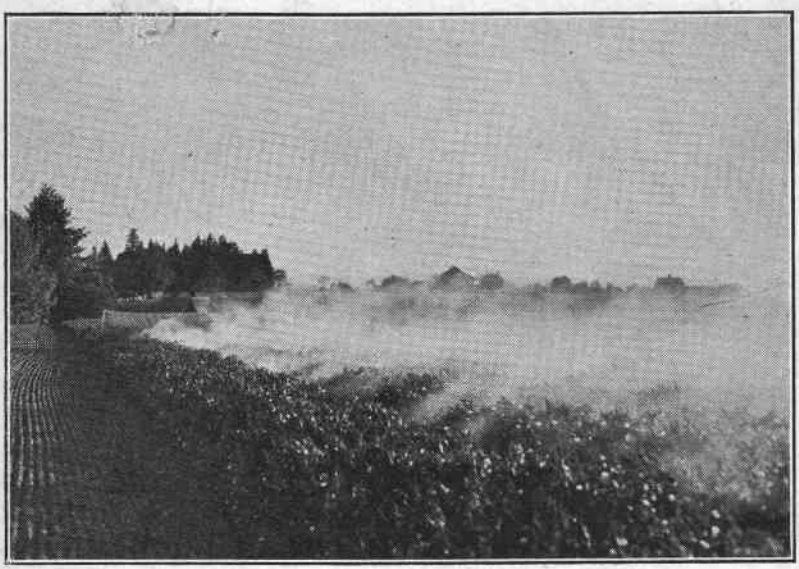

Figure 7. The hood forces the dust down into the vines before it can be blown away by wind.

As may be seen in the illustrations, dusters may be built on any conveyance which will travel through the fields. Tractors, trucks, cars, and trailers have all been used. The only essential point is that the equipment be able to travel over the field at a reasonably uniform speed.

It is not assumed in this discussion that a perfect duster for pea-weevil control has been built or that it can be designed from these directions. Each machine built thus far has been an improvement over the previous equipment. One objection to most machines used thus far is that too much time has been lost in setting up and taking down the hoods. One of the first machines built was so constructed that the wings had to be taken off and hung on the side of the car in order to be moved from field to field. This required more time than was necessary to dust 5 acres of peas. Figure 10 illustrates a very simple device whereby the wings were swung up while moving; but difficulty in passing telephone and power wires was experienced with this machine. The latest design shown in Figures 11 and 12 eliminate both of these inconveniences. The wings in Figure 11 fold and swing around to the side of the machine. This may be done by one man in less than two minutes. The hood in Figure 12 may be telescoped when

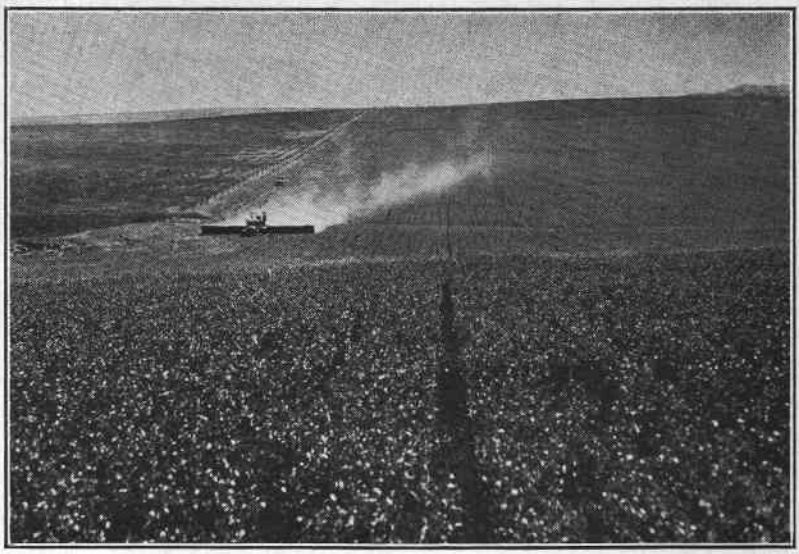

Figure 8. Although warm, windy conditions prevailed, 100 per cent kill of weevils was obtained at this time.

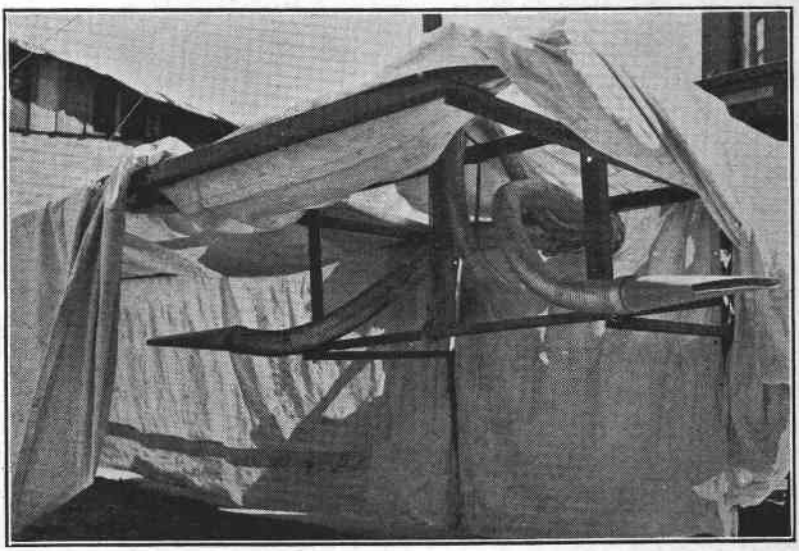

Figure 9. The simplest duster design used had one large nozzle directed into each wing and one smaller, central nozzle directed forward.

not in use. When in operation it is held at full extension by pins through the supporting rods. With this simple arrangement it is also possible to adjust the hood to varying lengths.

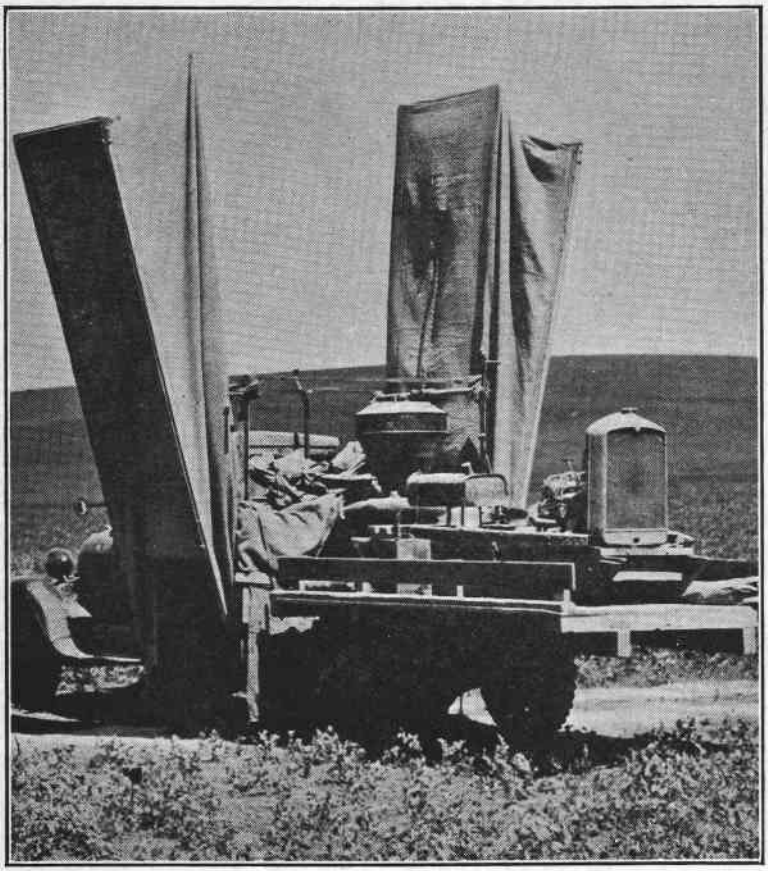

Figure 10. Little time is lost when moving from field to field by this simple design whereby the wings may be swung up when not in use. This arrangement also permits the independent adjustment of each wing for height while the machine is operated. *Photograph by Frank Hinman.*

INJURY CAUSED BY DUSTING EQUIPMENT

Dusting equipment run through the pea field causes some damage to the crop. This is not considered serious, however, since few of the vines run over by the wheels of the equipment are actually destroyed. Many of the vines are bent down but quickly recover. In treating tall vines, cutting will be facilitated by running the duster in the opposite direction to that traveled by the swather.

DUST MATERIALS AND RATES OF APPLICATION

Rotenone-containing dusts are recommended for weevil control. Rotenone-containing sprays are apparently just as effective but are more expensive to apply and handle. The prepared dust should consist of three fourths of 1 per cent actual rotenone mixed with some inert carrier such as talc. Lime should never be used with rotenone, since it causes certain chemical changes which destroy the insecticidal value of the rotenone. In general, it has been found that three fourths of 1 per cent of rotenone in talc has been as effective in weevil control as higher percentages, although in cases where a very high weevil infestation occurs a 1 per cent dust may be advisable.

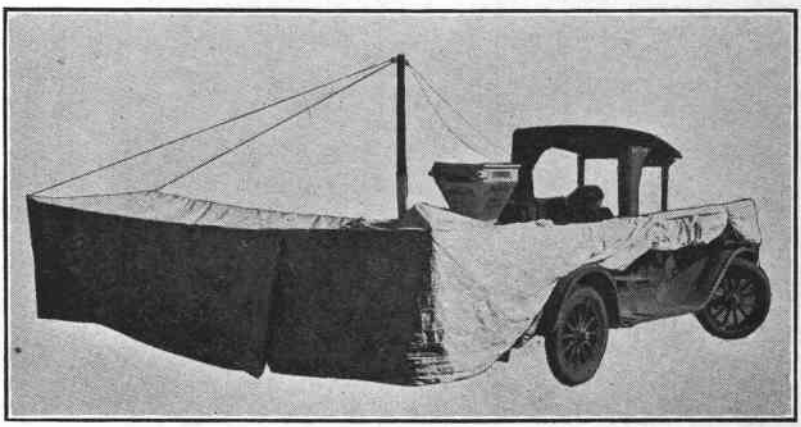

Figure 11. A recent design of hood supports permits the wings to be swung around to the side of the machine.

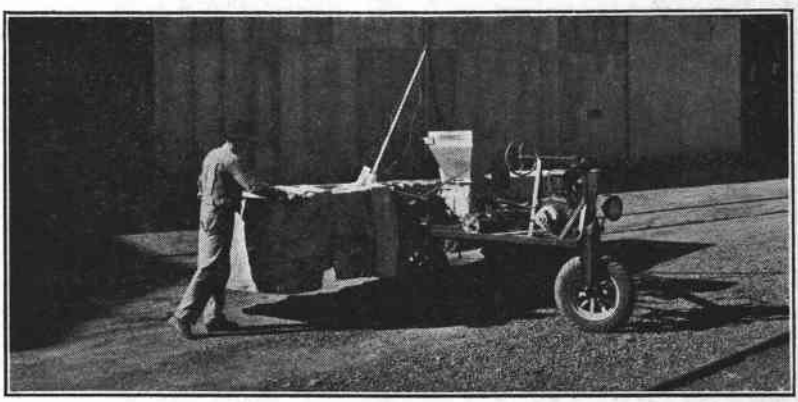

Figure 12. Hood supports which may be telescoped are a great improvement over many other designs.

Rotenone is an organic product which is contained in the roots of certain tropical plants. At present the two most important commercial sources are finely ground cubé and derris roots. The latter may give superior results with some insects, but we find no difference between the two as far as the pea weevil is concerned. Since cubé is at present substantially cheaper than derris, it is recommended that cubé be employed in the preparation of dusts for weevil control.

The amount of dust applied has varied in practice, but an application of a dust containing three fourths of 1 per cent of rotenone in talc at the rate of 20 to 25 pounds per acre covered is adequate for satisfactory control. The rate of dust application will vary with the dusting unit and speed of travel, and it will not be possible always to apply exactly the same amount of dust per acre. A variation of 2 or 3 pounds per acre is not important, but care should be exercised to see that the rate does not fall below 20 pounds.

INSECTICIDAL EFFECT OF ROTENONE-CONTAINING DUSTS

While rotenone-bearing dust is exceedingly toxic to the pea weevil and many other insects, it is harmless to livestock and human beings in the dilutions used for insect control, and it soon loses its toxic properties when exposed to atmospheric conditions. This constitutes one of its most desirable properties in comparison with many other materials, such as calcium arsenate.

With the pea weevil rotenone apparently acts as a stomach poison, and it must be taken into the alimentary tract of the insect before it is effective. The pea weevil feeds very little in the adult stage and does not pick up the dust in the course of its feeding, as do many insects. The feet of the weevil are provided with dense brushes of fine hairs (Figure 13) to enable it to cling more firmly to the smooth leaves and pods of the pea plant. The dust is accumulated in these brushes, which causes the weevil to clean them frequently by drawing the feet through the mouth parts. It is apparently in this manner that the weevil ingests enough of the poison to cause death. Rotenone-containing dusts are effective for only a brief period after dusting, hence the importance of timely applications.

FIELD INFESTATIONS IN RELATION TO THE AREA TO BE DUSTED

Some pea weevils tend to leave their winter hibernation quarters as early in the spring as warm sunny weather occurs. Unless there are peas in bloom at this time, these weevils will again go into hibernation if the weather turns cold, or if temperatures are high will drift around until blossoming peas are found. In moving into a newly blossoming field the weevils tend to settle on the first blooms they encounter. This results in a high concentration of weevils around the edges of fields. If not killed

at this time, they will gradually spread through the field until the entire area is infested. It is therefore important to dust fields as soon after infestation as possible.

Because of the weevils' habit of first infesting field edges, it is unnecessary to dust the entire acreage of larger fields. Tree or brush-lined gullies, buildings, or patches of woodland which may occur as "islands" in some of the larger fields will provide hibernation quarters for numerous weevils, and the peas adjacent to such areas are as likely to be infested as the actual outer borders themselves. A large pea field illustrating this point is shown

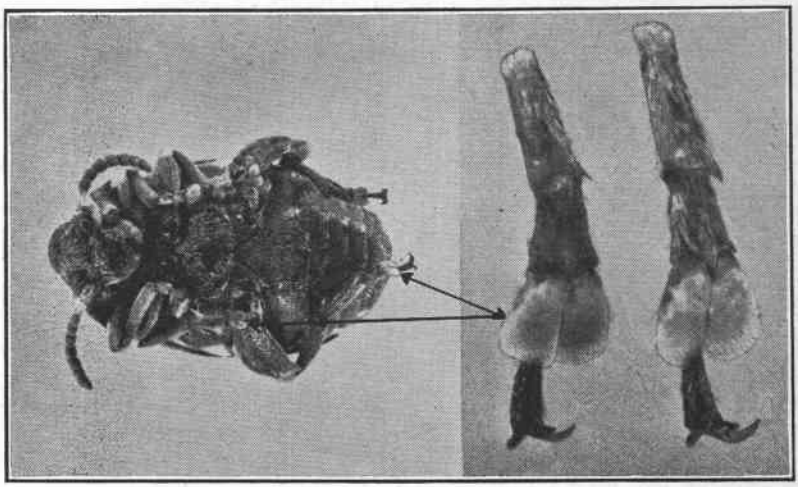

Figure 13. The feet of the weevil are provided with the dense brushes of fine hairs. These accumulate dust which is cleaned off in the mouth. Thus the poison is taken into the insect stomach.

in Figure 14, A. In this field the edge along the fence shown at the right will probably be heavily infested. This field could be protected by dusting a strip or zone 150 to 250 feet wide around the edges. The peas surrounding the tree-lined gully shown in the middle distance would probably also require dusting, since hibernating weevils would disperse from this area and infest the surrounding peas.

Fields or parts of fields close or adjacent to suitable hibernation quarters are almost invariably more heavily infested than those fields or parts of fields more distant from such areas.

In certain cases two or more varieties of peas of different blooming dates may be planted in a solid block. In such cases the field margin of each variety must be considered a field border for dusting purposes. Weevils will drift across a large field of late peas and infest the adjoining margin of an early planting.

Even in a large field of a single variety, exposure, soil conditions, or other factors may cause isolated portions within its borders to bloom ahead of the actual field margins. In such cases these "islands" of early blooming peas may become infested and require treatment as well as the field borders themselves.

It is recommended that all fields of 10 acres or less have their entire area dusted unless infestations are light and center areas are *known* to be weevil-free. In larger fields the field edges should be dusted to a depth of not less than 150 to 200 feet unless actual infestations are known to be concentrated in a narrower zone. In some cases where weevils are excessively abundant it will be necessary to dust a marginal zone even wider than that indicated above. For large-scale control campaigns, each field should be mapped and the weevily areas indicated to serve as a guide for making dust applications.

Weevils do not all leave their hibernation quarters at one time. It has been found that large movements (migrations) occur on days when the weather conditions are favorable but that such movements cease under unfavorable conditions and are not resumed until warmer weather again occurs. Information at present available indicates that heavy weevil flights occur on warm sunny days when the maximum temperature reaches 75°-80° F. No weevil movements of any magnitude have been observed when temperatures were as low as 65°-70°.

TIME AND NUMBER OF APPLICATIONS

The proper timing of dust applications is essential to successful weevil control. Unfortunately no definite and universally applicable rules can be laid down on this important point, since it depends on factors which vary with seasonal conditions. The advice of a competent field entomologist will often prove necessary in this connection.

In the lower Willamette Valley in 1937 it was found necessary to make two dust applications to the infested portions of fields of early-season peas (those blooming in May and early June). It is quite possible that three applications may be necessary to protect early-blooming but late-maturing varieties.

With late-blooming peas (middle June to July), where weather conditions were such that most of the available hibernating weevils had moved into the fields at the time of first blooming, one dust application was sufficient. Finally, in the case of very late peas, it was unnecessary to dust at all since available weevils had previously moved into earlier fields and had been destroyed by dusting. Where weevils are not controlled in early peas, the survivors will disperse at harvest and may seriously infest late fields of peas which are just coming into bloom. All these factors must be kept in mind when determining the number of dust applications.

The first dust application should be made in all cases within a few days after the peas start to bloom and before any pods have set (Figure 14, B). The object of this is to kill the weevils before egg-laying has occurred. Eggs laid prior to dusting can be expected to produce living larvae, which will infest the peas regardless of later treatment.

The timing of subsequent applications will depend on various factors. Unless all weevils are out of hibernation at the time of the first application (which will occur only in the case of late fields), further movements of weevils into the developing peas may be expected. If this occurs within a few days after the first application, the second dust should be applied

within 4 or 5 days of the first. The interval between dustings should be longer if the influx of weevils is delayed. A week to 10 days between applications will probably be about right in most cases. In the event a movement of weevils into the peas occurs following the second application, a third dust may be necessary unless the peas are within a week or 10 days of harvest. In this case the eggs deposited by the late incoming weevils will probably not hatch in time to infest a significant number of the peas.

In connection with the timing of dustings, it is important to remember that newly incoming weevils are largely concentrated around the field edges. As far as possible dusting should be done before there has been time for the weevils to move farther into the fields, thus necessitating the dusting of a wider border.

Figure 14.

A: Brush occurring as "islands" in pea fields provide hibernation quarters for numerous weevils. Such an "island" is shown in the gully in the middle distance of this photograph. The surrounding portion of the field shown receives the same treatment as the margins of the field.

B: The first dust application is made shortly after the peas begin to bloom and before pods are formed.

BORDER TRAP CROPS

A strip about 10 feet wide of an earlier blooming variety or an earlier planting of the same variety is planted around the entire margin of large fields in some pea-growing areas. This is known as a "border trap crop,"

since this method is used to attract the weevils to these limited areas, where they may be destroyed and thus prevented from infesting the main plantings. To be effective, the border should come into bloom a week to 10 days before the main planting. This border is then destroyed by plowing under after it is out of bloom. This practice, where feasible, has proved beneficial, but is beset by certain dangers. Border trap crops which are not treated to prevent egg deposition may serve as a continuing source of weevil infestation. Weevils which have been attracted to an early-blooming border and not destroyed are ready to begin depositing eggs as soon as the main field comes into bloom. A poor stand or weak vines with sparse bloom in a border reduces its effectiveness.

Dr. T. A. Brindley, United States Bureau of Entomology and Plant Quarantine, Moscow, Idaho, who has conducted most of the investigations with border trap crops, makes the following recommendations relative to their care:

"1. *As much care should be exercised in the choice of seed and in the preparation of the seed bed of the strip as is exercised in the planting of the main crop.*

"2. *Border strips should be dusted at least once before any pods have formed on the vines.* If possible, the border should be kept from becoming infested in order to insure that no weevils will develop within it.

"3. *Border strips should be plowed under as soon as they have gone out of bloom.* This is particularly important if any of the peas have become weevil infested. Otherwise, these strips may become a serious source of weevil infestation."

The use of border trap crops is not considered feasible in the small fields of western Oregon and Washington.

SANITATION MEASURES

Viner refuse should be handled so as to prevent the escape of weevils. There are several ways of disposing of these vines; they may be put up for ensilage in silos, piled in stacks, spread over the ground and plowed under, or dried for hay. Few if any weevils escape from vines used for ensilage. Vines that are spread on the field and plowed under immediately are probably not an important source of weevil infestation. The practice of drying the vines for hay offers a good opportunity for weevils to complete their development and escape to infest the following year's crop. If this hay is baled and fed early, the number of escaping weevils may be greatly reduced.

The peas lost on the field in the harvest operations are a source of weevil infestation for the following year. This source of infestation may be greatly reduced by plowing the peas under to a depth of 6 to 8 inches immediately after harvest (Figure 15). This applies to both canning and seed peas.

Seeds containing living weevils are a source of infestation because large numbers of weevils are able to escape from such seed and infest the crop.

COST OF WEEVIL CONTROL

Definite cost figures cannot be given. Cost of materials and labor will vary from year to year, but approximate figures obtained in the 1937 season may be used as a basis for a purely theoretical consideration. For two applications, allowing 23 pounds of dust per acre per application at an

Figure 15. The peas offering a source of infestation for the following year are destroyed by plowing deeply immediately after harvest.

assumed price of 7.5 cents per pound, and allowing 75 cents per acre per application for rental of the machine and labor of the operator, the cost would be $4.95 per acre treated. Where fields are large enough and are uniformly square or rectangular, border dusting may be done. The cost per acre protected will thus be reduced. The larger the field the more economical the operation. For example, in treating a 50-yard border on a 3-acre field the entire field is covered, so that the cost is $4.95 per acre, but in treating an 80-acre field only 23.65 acres are covered, which reduces the cost of protecting the entire field to $1.46 per acre. It is to be remembered that these figures are presented merely to emphasize the general fact that large, uniformly rectangular fields are desirable.

IMPORTANCE OF SUPERVISION IN WEEVIL-CONTROL CAMPAIGNS

The proper planning of a large-scale dusting program for weevil control is a complex and specialized task calling for the utmost competence, experience, and industry, if satisfactory results are to be obtained.

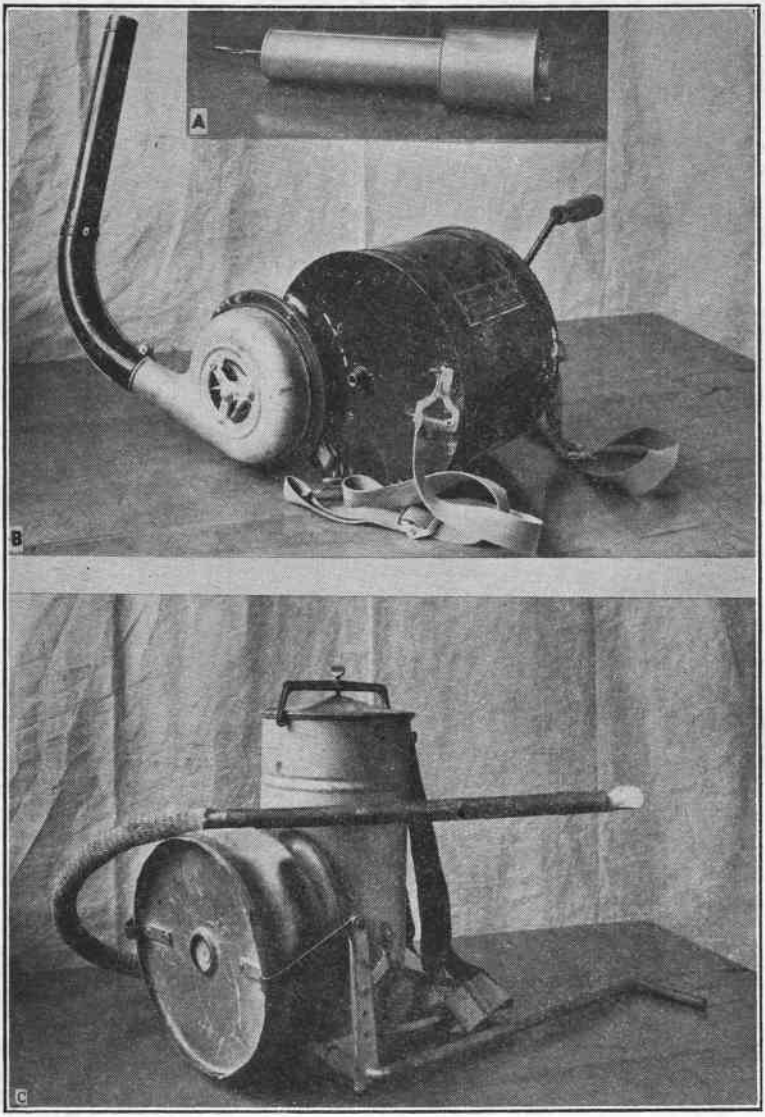

Figure 16.

A: A "plunget-type" hand duster is suitable for use in home gardens where only a few feet of row are planted to peas.

B: A "fan-type" hand duster is usable on home gardens.

C: The "bellows-type" hand duster has given good results on small garden plots.

It is strongly recommended that any extensive operations along the line of these recommendations be under the direction of a competently trained man with an intimate knowledge of the weevil and its habits, and the ability to plan and execute a sound program. Such a man should be given full authority to see that all operations are fully and thoroughly carried out in the light of a detailed knowledge of the territory and all the conditions under which the work must be done.

In the accomplishments of this program of control practices, active participation by the cannery, the pea growers, and the entire agricultural and urban community is necessary. This can hardly be overemphasized. For example, if only one grower in a community refuses to follow control recommendations, the weevils propagated on his tract will infest the peas of his entire community the following year.

HOME GARDENS

Small plantings of all pea varieties in home gardens are even more likely to be weevil infested than are large commercial plantings. Weevil-infested garden plots not only provide an inferior product for home consumption but also constitute an important source of weevils for the infestation of nearby commercial plantings.

The control of the weevil in such plantings is readily accomplished by the application of three fourths of 1 per cent rotenone dust by means of any good hand duster. Several types of hand dusters which have given satisfactory results in this connection are shown in Figure 16 (A, B, C).

For home gardens it is recommended that the peas be dusted as soon as they come into bloom and before any pods have set. Dusting should be repeated thereafter at intervals of 5 to 8 days until the peak of production is reached. As soon as the peas get beyond the edible stage the vines should be destroyed. This will prevent any eggs deposited by late-incoming weevils from hatching and developing. Unless this is done weevils will mature, enter hibernation, and thus live to infest peas planted the following year. The pulling and feeding of the vines before the peas are dry is probably the best practice to follow, otherwise piling and burning are recommended.